

The Quality in Health Information Systems Study: Perceptions of the quality of digital health information systems in the global health domain.

Assem Toleugazinovna Suleimenova

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Nancy Puttkammer
Jan Flowers

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Assem Toleugazinovna Suleimenova

University of Washington

Abstract

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Assem Toleugazinovna Suleimenova

Chair of the Supervisory Committee:

Nancy Puttkammer

Department of Global Health

This study explores the diverse perspectives of stakeholders on the definition and concerns surrounding the quality of electronic medical records (EMRs). Furthermore, it illustrates how the EMR quality aspects can be mapped into the STEEEP framework. Several trends emerged, including a heightened concern for clinical decision support and data quality by EMR builders and implementers, a high focus on stakeholder engagement and capacity building for decision makers, and a strong focus on technical aspects of EMRs for domain experts. Effectiveness and efficiency were identified as key domains, focusing on clinical decision support, data availability and quality, and meeting functional requirements. It was noted that interoperability and data exchange were emphasized across a number of domains, while patient-centeredness and equity were given relatively less attention. Quality assessment and implementation were also identified as critical factors, emphasizing the importance of stakeholder engagement and planning. The study made several recommendations, including the need for user centered EMR design, standard data sharing, and further investigation of equity issues.

INTRODUCTION.

Background.

Electronic medical records (EMRs) represent one of the most significant achievements of information technologies in health care, and they can be highly effective if successfully implemented and adopted (Evans, 2016, Tsai, 2020, Fennelly, 2020). The development of EMRs has been ongoing in both High-Income countries (HICs) and Low- and Middle-Income countries (LMICs) for several decades, with HICs making significant advancements in EMR adoption and development, while LMICs have been slower to adopt EMRs due to various challenges. Despite these challenges, the implementation of EMRs has been recognized as an essential step towards improving healthcare delivery and patient outcomes in both HICs and LMICs. The use of EMRs was widely recognized by large health care organizations and government agencies by 2015 (Ratwani, 2017). In the context of rapid, constant changes in the healthcare environment and in information technology, it is not clear that EMRs are meeting their full potential (Shahmoradi, 2017). Health information systems (HIS) and quality are discussed in several publications available on the Internet (Buntin, 2011, Uslu, 2021, Feldman, 2018). In the US, much focus has been on quality in healthcare, including the development of the Institute of Medicine's (IOM) STEEEP framework outlining the six domains of healthcare quality: safe, timely, effective, efficient, equitable, patient centered (Six domains of Healthcare quality, 2022). But that focus is on the quality of the care given, not on the quality of the digital health systems supporting the care provided. With the increasing digitization of health information systems in global health settings, digital health transformation is occurring more rapidly in more challenging environments and with fewer resources, leading to potentially less control over the factors that would constitute high-quality EMR software and implementation.

As EMRs become more ubiquitous, there is interest in understanding their quality as a healthcare intervention, and the six STEEEP domains provide a useful framework for exploring definitions of quality of EMRs (IOM, 2001). Despite the abundance of literature on EMRs, there is a noticeable lack of consensus regarding the quality of EMRs and the mechanisms by which they influence healthcare quality. It is crucial to acknowledge that EMR quality in this context encompasses more than just technical aspects and characteristics. It is important to understand that the perspectives of various stakeholders regarding the quality of EMRs differ according to their roles and responsibilities. Developers and implementers may focus on the technical aspects of EMRs, such as system reliability, interoperability, and ease of use (Fennelly, 2020, Reisman, 2017, Aguirre, 2019). Funders and decision-makers may prioritize the cost-effectiveness and long-term sustainability of EMR systems (Moucheraud, 2017, Alami, 2020). Users, including healthcare providers and patients, may value EMRs that are easy to navigate, secure, and facilitate better communication between providers and patients (Manca, 2015, Uslu, 2021, Papoutsis, 2015, Rathert, 2017, White, 2013). In general, stakeholders are in agreement that high-quality EMRs should enhance patient care, reduce medical errors, and increase efficiency in the delivery of healthcare (Lin, 2020). Achieving these goals requires collaboration among all stakeholders to ensure that EMRs meet the needs of everyone involved in healthcare delivery. In today's rapidly evolving healthcare landscape, the importance of digital health interventions cannot be overstated. However, the implementation of such innovations in clinical practice is often met with several challenges, making proper evaluation studies a necessity. Several experts in the field have proposed a model for continuous evaluation of digital health interventions, aimed at ensuring successful implementation and improving quality of care (Jansen-Kosterink, 2020, Reis, 2016). The authors emphasize the importance of identifying theoretical or

interpretive frameworks to guide the implementation or evaluation of digital health interventions, as they provide researchers with guidance and clarity on these approaches (Soobiah, 2020).

Defining operational mechanisms and metrics to measure the quality of critical components and processes is necessary for promoting quality evaluation of Health Information Systems (Noël, 2022).

The existing literature provides valuable insights into various aspects of EMR quality and its impact on healthcare services. However, previous studies have not provided a specific definition of EMR quality. Instead, they have focused on the broader concept of healthcare quality by utilizing EMRs. It is crucial to assess EMRs and leverage them to support patient care for improving healthcare quality (Reis, 2016). Creating alerts and reminders for providers has shown clinical decision-making and workflow support, resulting in improved treatment (Compeau, 2017). Additionally, routine data quality assessments were used to assess the quality of EMR data, leading to a decline in missing data and improved data concordance (Janett, 2020).

There is a need for further research that specifically examines the quality of EMRs in the context of low- and middle-income countries using a well-defined and structured definition of EMR quality. Therefore, this study aims to address this need by providing a clear definition of EMR quality and evaluating it across the six domains of the STEEEP framework.

The assessment of digital health systems is a complex task that requires consideration of various perspectives and stakeholder viewpoints. The research aims to explore the definitions of quality of EMRs from the perspective of different stakeholders, including decision-makers, users, developers, product owners, and funders. This research question is particularly relevant in the context of the increasing use of EMRs in healthcare systems, as the success of EMRs largely depends on their quality and ability to meet the needs of different stakeholders.

By identifying the different definitions of quality, the research can provide insights into the priorities and expectations of different stakeholders and highlight areas that require improvement. We noted earlier that previous research discussed the perceptions of developers and implementers (Fennelly (2020), Reisman (2017), and Aguirre (2019). Moucheraud (2017) and Alami (2020) examined the perspectives of funders and decision-makers. Additionally, Manca (2015), Uslu (2021), Papoutsi (2015), Rathert (2017), and White (2013) have provided insights into the viewpoints of users. These data provide some preliminary insight into their varying priorities and expectations. In spite of this, it is important to point out that the prior research cited did not specifically address this research question, suggesting that further investigation is needed to comprehensively understand how different types of stakeholders perceive and evaluate quality in EMRs. By understanding these different perspectives, it may be possible to identify areas where stakeholders have conflicting priorities, and to develop strategies to address these conflicts.

Overall, the research has the potential to provide valuable insights into the complex landscape of EMR quality and to identify opportunities for improvement. By considering the perspectives of different stakeholders, the research can help to ensure that EMRs meet the needs of all stakeholders and contribute to the delivery of high-quality healthcare services.

METHODS.

Study setting.

The study was conducted at the University of Washington with support from the Digital Initiatives Group at I-TECH and the University of Washington School of Nursing. We conducted

qualitative one-on-one online interviews with individuals who interact with EMRs. Participants were interviewed during the period of November 2022 - January 2023.

Study population.

The participants in this study were information technology professionals and organizational leaders working globally with digital health tools, representing the following categories: EMR builders and implementers, decision makers, and domain experts. Participant selection was purposeful and sought to achieve balance by gender (with equal participation of men and women) and by professional characteristics (i.e., nature of the position). The inclusion criteria were English-speaking individuals with current global health professional roles involved in the selection, design, implementation, or use of digital health systems. An informed consent agreement was also a requirement for inclusion in the study. Using a purposive sampling approach, participants were recruited through the research team's professional and organizational contacts. We also used a snowball sampling technique with referrals from the first round of participants to find additional informants, thereby expanding the geography of participants and ensuring participants extended beyond the professional networks of the research team.

Interviewees were contacted via email with direct outreach from the study team.

Participants were presented informational slides about the study at the beginning of the Zoom meeting. Interviewees were asked to give their verbal consent before audio recording could begin. All interviews were audio recorded without any facial recording.

Data collection/procedures.

Our interviews were semi-structured and consisted of demographic questions, questions regarding digital health tools in general, and specific questions regarding EMRs. The first set of

questions related to the interviewee's background, experience, and current role in healthcare, as well as their perspective on selecting and investing in digital health products, and their definition of "good quality" for a digital health tool. The focus then shifted specifically to EMRs, with questions about the interviewee's thoughts on EMR quality, their understanding of how EMRs fall short of quality, their sense of responsibility in ensuring quality, and their criteria for determining the quality of an EMR. The final question explored what factors other stakeholders might consider when assessing the trustworthiness of an EMR, and whether there were any additional experiences or insights the interviewee would like to share regarding EMR quality or trust. The semi-structured interview guide is included in Appendix I. Interviews were transcribed using the Zoom recording transcription and additional corrections were made by team members. An identification number was assigned to each transcript, without any personal information.

Before conducting formal interviews for a study on EMR quality, three pilot interviews were conducted with several colleagues who interact with EMRs. These preliminary interviews allowed the research team to identify potential issues with the initial questionnaire guide and to modify the questionnaire to ensure the questions were clear and relevant. Results of these interviews are not included in the analysis.

Data analysis.

Data coding and analysis were conducted by two different researchers after the interviews were finished and transcription had been completed. During the data analysis process, the research team employed a number of strategies to ensure the quality of data analysis. One of these strategies was to hold regular team meetings where all codes and quotes were discussed in detail.

This helped to ensure that the codes and quotes were accurately represented and interpreted, and that any discrepancies were addressed and resolved. By engaging in a collaborative process, the research team was able to draw on diverse perspectives and experiences, which helped to strengthen the overall quality of the analysis.

The development of a codebook was based on the six STEEEP dimensions of quality of care outlined by the National Academy as applied to participants' perceptions about what makes for a quality EMR the quality definitions of EMRs. Codes and themes were created by using Dedoose software (Dedoose, 2023). Codes were developed by using a hybrid approach: inductive and deductive. Two analysts (AS and JF) applied the codebook independently to 27 transcripts in order to identify emerging codes and points of divergence indicating codebook clarification is necessary.

After reading the transcripts, the main preliminary codes based on the six domains of healthcare quality were applied to the transcripts (deductive approach) by the primary analyst. As we completed the coding process, similar groups of codes were merged into themes in accordance with the perceptions of the interviewees. The codebook was reviewed and refined by a second analyst in the course of analysis to ensure their accuracy and reliability, with any discrepancies discussed and resolved to strengthen the validity of the study's findings.

The coding team created analytic memos to synthesize themes reflecting dimensions of quality of care. The analysis examined quality dimensions in the context of stakeholder definitions of quality based on their roles and expertise. By discussing these quotes, we were able to clarify any confusion and gain a deeper understanding of the interviewees' perspectives.

Ethical approval.

An IRB application was submitted through the Human Subjects Division (HSD) zipline at the University of Washington. HSD determined that our proposed activity met the criteria for exempt status (Category 2 after reviewing the proposal) (Study00016157).

RESULTS.

Participant characteristics.

A total of 27 participants, 18 male and 9 female, participated in the interviews (Table 2). We classified the participants into three distinct categories based on their roles and experiences: EMR builders and implementers, domain experts, and decision makers.

EMR builders and implementers were individuals who possessed the technical knowledge and expertise necessary to design and operate EMRs. They had experience with a variety of EMR software and hardware and were well versed in the technical aspects of the EMR implementation and maintenance process. 16 people (59.3%) participated in this category, including developers, implementers, and project managers.

Domain experts were experts in digital health or specific areas of health informatics, like data analytics, but were not involved in day-to-day system implementation as their primary roles. They had a deep understanding of the underlying technology, as well as the clinical and regulatory implications of digital health solutions. In this category, there were 5 (18.5%) participants, who were researchers, data analysts, business analysts, project managers, or others who had experience monitoring and evaluating digital health solutions.

Lastly, decision makers are those responsible for making strategic decisions related to the use and implementation of EMRs within an organization or in a country. There were 6 individuals (22.2%) in this category, including executives, managers, funders and representatives of Ministries of Health.

Based on the country of residence, the distribution of participants was as follows: Kenya - 5, Uganda - 4, USA - 4, Malawi - 3, Nigeria - 2, and others one from each of the following countries: United Kingdom, Cameroon, Zimbabwe, Mozambique, Namibia, Rwanda, South Africa, Switzerland, Tanzania. The countries were combined into four regions: East Africa, West Africa, South Africa, and others. Out of the total participants, 11 individuals had 1-4 years of experience, 7 had 5-8 years of experience, while 8 had more than 9 years of experience.

Among the 27 interviews, the duration ranged from 18 minutes to 51 minutes, with a mean of 38 minutes. The study participants were from 14 different countries.

Dimensions of quality from the perspective of stakeholders.

Participants' responses regarding the quality of EMRs were classified into six categories based on the six dimensions of healthcare quality: safety, timeliness, effectiveness, efficiency, equity, and patient-centeredness. Themes related to all six dimensions of quality in the STEEEP framework were identified by the respondents (Table 3).

Besides, participants also discussed two additional areas that were not tailored to the six dimensions of healthcare quality but were still considered significant aspects of EMR quality. The first was implementation, which refers to the process of adopting and integrating an EMR system into a healthcare organization. Participants emphasized that effective implementation is

crucial to achieving high-quality EMRs, as it can impact the usability, functionality, and overall effectiveness of the system.

The second area highlighted by participants was EMR quality assessment, which involves evaluating the performance and outcomes of an EMR system. Participants emphasized the importance of ongoing assessment to ensure that the EMR system is meeting the needs of healthcare providers and patients and is functioning as intended.

Safety.

The definition of "safety" is "Avoiding harm to patients from the care that is intended to help them." (Six domains of Healthcare quality, 2022). According to respondents, EMR systems must prioritize security, reliability, quality control, and privacy to safeguard patient data, reduce errors and adverse events, and prevent unauthorized access. As an integral attribute of the quality of EMRs, safety was almost equally emphasized by all three categories of participants. The domain safety accounted for 8.2% of all coded segments from the group of EMR builders and implementers, 8.7% of all coded segments from the group of decision makers, and 9.7% of all coded segments from the group of domain experts (Figure 1).

Theme 1. EMRs protect safety and confidentiality of patient health data.

EMR builders and implementers emphasize the importance of protecting patient data by reducing errors and preventing unauthorized access. "I am a strong proponent of proper data governance structures we should go beyond the system itself. Those environments where we implement should have very clear and unambiguous data governance structures: who should access what? And how do we share data in an enabling, but also in a manner that protects patient

confidentiality” (EMR builder and implementer). It has been emphasized by decision makers that usability testing and user training play a significant role in the security of EMRs: “ If you introduce a system to somebody else who's not well trained or who's not using it correctly, as supposed to be used that may lead to problems in terms of how well the quality of data that's collected using the system” (decision maker). Ensuring data protection and implementing back-up recovery measures can also contribute to patient safety: "So, that there is a service somewhere usually in the facilities individually which has to be backed up and supported. and it is cloud based, obviously, then, you have to be pretty confident your Internet can be stable and have good work around. ... So that you don't end up losing that critical level of data, completeness and quality that you had established" (domain expert).

Theme 2. EMRs are aligned with clinical workflows, ensuring that data is accurate and complete.

According to the decision-maker, the tool may be harmful if it does not support clinical decision making and is not aligned with the workflow: “If it gives inaccurate diagnosis or makes recommendations for inaccurate diagnosis ... or even dosing recommendations, so, for example, you may enter the weight of the patient or the age of the patient ... and so on. And then it gives the wrong dosing information ... So, those areas I feel the EMR could be harmful even to the patient as opposed to being supportive to clinical care” (decision maker). As noted by another decision maker, usability testing plays an important role in safety. In addition, they noted that usability testing is an important part of safety: “One of the things is that uh just being sure that systems are well tested before they are traded out in that real um in in a real implementation. So, that as much as possible, besides just dividing, I mean, removing like errors, systems errors from

the system, it's also just being sure that the logic functions correctly, the decision support is working correctly” (decision maker).

Domain experts emphasized the importance of ensuring that the implementation of EMRs is integrated with clinical workflows in a way that does not negatively impact patient safety or lead to harmful consequences: “I think not only is there like making sure that the tool aligns with the business process needs and the stated requirements. But then ... ensuring that the tool is doing no harm, which I think is a lot more challenging” (domain expert).

Although respondents generally viewed security as creating no harm to patients, some differences of opinion can be observed: EMR builders and implementers place a high priority on protecting patient data through data governance and backup recovery systems. Decision makers highlight the role of usability testing and training for data security and accuracy. Domain experts emphasize integrating EMR implementation with clinical workflows to ensure patient safety and data integrity.

Timeliness.

The definition of “timeliness” is “Reducing unwanted waits and harmful delays for both those who receive and those who give care; reducing access barriers and financial risk for patients, families, and communities; and promoting care that is affordable for the system” (Six domains of Healthcare quality, 2022). Timeliness is an essential aspect of healthcare quality that refers to providing healthcare services in a timely manner (Hannawa, 2022). Timely healthcare delivery is critical because it ensures that patients receive the care they need when they need it, which can often be a matter of life or death (Institute of Medicine, 2002, Prentice, 2007). Timeliness

involves ensuring that patients have timely access to healthcare services, including appointments, diagnostic tests, treatments, and medications (Committee on Optimizing Scheduling in Health Care, 2015). According to participants, timeliness was linked to the ability of EMRs to facilitate clinical workflow and decision-making processes in a timely manner, to ensure access to patient data and to generate timely reports, as well as the capability of exchanging information between systems in a timely manner without wasting time. Among the group of EMR builders and implementers, the domain timeliness accounted for 22.3% of all coded segments; among the group of decision makers, it accounted for 23.5%; and among the domain experts, it accounted for 20% (Figure 1).

Theme 3. EMRs provide timely support for clinical decisions and workflows.

Supporting clinical decision-making can be aligned with several domains of healthcare quality, including safety, effectiveness, patient-centeredness, and timeliness. According to our respondents, quality digital health tools are tools that aid healthcare providers in delivering optimal care, save time, and improve the quality of patient care. “Health care workers with seeing the clients, what is convenient for them, what is turnaround time, this is time they spend with clinicians, what facilitates movement of information from the health provider to the patients” (EMR builder and implementer). It was stressed that the system should be fast: “The response should be that fast, you know, so that there's almost no time lag between me and my patient” (EMR builder and implementer). In some cases, the term “quality” referred to clinical decision support in a timely manner: “I think also a quality digital health tool is a tool that provides ... assistance in terms of seeing the client ... it should assist the health care worker to do the work better by giving prompts ... I also think that a quality digital health tool should

remove certain aspects of health care workers' wait by automating those aspects” (EMR builder and implementer).

Healthcare quality is also referred to as a continuum of care, which can be supported by EMRs and interoperable systems. In the absence of integrated information "you're losing time. You don't have integrated information. You cannot ensure longitudinal patient care, you can't ensure continuity of care. You can't make informed decisions" (EMR builder and implementer).

Interoperability requires the use of standardized data formats, robust security protocols, and efficient data exchange mechanisms: “Then also interoperability between the systems across facilities ... at the moment there are a lot of blind spots around, not knowing, especially in ... developing countries ... if you have a lab system being interoperable with that, say, to return blood test results back to the facility. So that type of data ... for data exchange. And then also just ensuring that data is available across facilities” (domain expert). Interoperability can support other areas in the healthcare setting: “I'm talking about the stock management for pharmacy, ... information is available in a timely manner ... So, we know that this information works together, at the end of the day we want to be able to have interoperability on each piece of the system come together” (domain expert).

Theme 4. EMRs empower timely patient care with fast and secure data exchange across all EMR locations.

Availability of digital information on a timely basis refers to the ability of the EMR to provide access to up-to-date patient information and medical records in a timely manner. This can help healthcare providers make more informed decisions and provide more effective treatments: “I

think the other one is also with a generation of the reports. The system, or the tools, are able to regenerate the information within a quick turnaround of time, and those reports, you know, they can be used for various purposes, you know, they can be used for continuous quality improvement, looking at whatever indicators that, you know, one maybe interested in, how each of the indicators are performing and which areas would need possibly to the clinician would need to pay attention to” (EMR builder and implementer). “Another thing is maybe an EMR is taking too long to generate reports. One of the data quality or the system quality criteria is timeliness” (EMR builder and implementer).

This also can help to improve the quality of care by facilitating communication between healthcare providers, ensuring that patients receive the appropriate care and treatments, and avoiding unnecessary delays and errors: “Within a medical record if it is properly implemented ... you don’t have to move a folder from one health care worker to another, from the triage nurse to a consultant or a physician ... to lab or pharmacy without necessarily moving folders. So these give you time means the patients spend less than waiting for this for them on our processes to happen” (EMR builder and implementer).

Timeliness is a crucial aspect of healthcare quality that can improve patient outcomes and increase patient satisfaction. It involves providing timely access to healthcare services and data, as well as ensuring a positive patient experience by reducing waiting times and improving communication: “If I have to wait for a long time waiting for the special record come up, come back, and then the patient looks at me as like: ‘What's this doctor doing with the computer?’ They're attending to me or the computer. So, it should be fast. The response should be that fast, you know, so that there's almost no time lag between me and my patient” (EMR builder and

implementer). “Timeliness” was the third most mentioned aspect after “effectiveness” and “efficiency”. In addition, timeliness is mostly mentioned by EMR builders and implementers. 22.3 % of all coded segments from the group of EMR builders and implementers were about the “timeliness” aspect, which was more than mentioned by decision makers and domain experts. Real-time, patient-specific recommendations refer to the ability of the EMR to provide immediate and personalized recommendations to healthcare providers based on the patient's medical history, symptoms, and test results: “And this tool should be able to help him to collect and analyze data, know his patients more, know his clients more, and able to act appropriately or make decision at the appropriate time about to the best interest of his patient, and also to give him enough time that the health workers to focus on his primarily calling” (EMR builder and implementer).

The fact that EMR builders and implementers are highlighting these aspects of the timeliness domain suggests that they are focused on developing and implementing EMRs that can improve clinical decision-making and provide timely access to patient information.

Effectiveness.

The definition of “effectiveness” is “Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (that is, avoiding both overuse of inappropriate care and underuse of effective care)” (Six domains of Healthcare quality, 2022). Domain effectiveness was the second most frequently mentioned domain. Within the effectiveness domain, respondents identified data availability and accuracy, interoperability and functional standards, and clinical decision support as important factors. In the group of EMR builders and implementers, domain timeliness accounted for 32% of all coded

segments; in the group of decision makers, it accounted for 34%; and in the group of domain experts, it accounted for 26% (Figure 1).

Theme 5. EMRs provide comprehensive and accurate data reports.

Effective healthcare requires healthcare providers to have access to accurate and timely patient data. EMRs have revolutionized the way healthcare data is stored and accessed, but accessibility alone is not enough. For clinical decision-making to be effective, the data must also be accurate and complete. Developers and implementers expressed concerns about this: “Low quality EMRs are EMRs first of all is not able to generate data. And even it is able to generate data, the data is not really useful, the reports are not of good quality. It’s only serving for clinical purposes” (EMR builder and implementer).

Theme 6. EMRs achieve consistent functionality and use at scale.

Software that has been successfully used in multiple sites, settings, or services, can be relied upon to be reliable and effective. “When I think about the quality of a system, I think about how scalable it is. Scalable to multiple sites, scalable to accommodate like tens or hundreds of patients or thousands of patients” (domain expert). Scalability is mentioned as an “open-source system you can modify it as other countries’ needs ... Because it is flexible, you will be able to scale it in every other context. If you implement it in urban centers, you can also implement it in rural centers” (Domain expert). Functional standards also play a crucial role in successful EMR implementation. These standards ensure that the EMR system is designed and implemented in a consistent and standardized manner, which reduces the likelihood of errors and increases the usability of the system. “I know in the US, for example, there is an environment where there is a system certification framework, where systems are actually certified for meeting some specific standards. I can confidently say, I tried to help the Government of Kenya get a certification

framework almost five years ago, and I've not succeeded. The document is still unpublished, as it is. But the most important thing if I was to choose an EMR, the easiest way would have been just to check whether it meets the requirements and using a certification framework” (EMR builder and implementer).

Theme 7. User-centered EMRs to optimize clinical decision support.

By using a user-centered design approach, designers can create products that are more intuitive, efficient, and effective. This approach can lead to improved usability, increased productivity, and higher user satisfaction, which can ultimately improve the overall quality of care in healthcare settings. 34% of statements in this theme were expressed by decision makers. “When you build systems with users, you're able to get very, very good systems. Because the users understand their workflows. For me it's about building systems for the users with the users” (decision maker). EMRs that were developed without user involvement were considered poor quality by some respondents, and they expressed 5 words that described the quality of an EMR: "Not very good, not very good, not very good. Those three are not very good and not very good. So most EMR systems, particularly in the Global South, most of them have been developed with very little input from the actual people who use them" (decision maker). Despite being aligned with the effectiveness domain, user-centered design also has a secondary safety component.

EMR builders and implementers spoke more about ensuring data quality and availability and adherence to standards, decision makers discussed stakeholder engagement and capacity building, and domain experts emphasized creating a user-centered design.

Efficiency.

“Efficiency” is defined as “Avoiding waste, including waste of equipment, supplies, ideas, and energy, and including waste resulting from poor management, fraud, corruption, and abusive practices. Existing resources should be leveraged to the greatest degree possible to finance services” (Six domains of Healthcare quality, 2022). Among the six domains of healthcare quality, “efficiency” was the most frequently referenced. 27.2% of all coded segments were related to efficiency which means that they considered it to be an important aspect of the quality of care (Figure 2). Builders and implementers of EMRs mentioned efficiency in 27.5% of their responses, decision-makers in 32.3%, and domain experts in 37.7% of their responses (Figure 1).

Theme 8. Financial impact of EMRs.

The financial aspects of EMRs are an important consideration for healthcare organizations when implementing and maintaining EMR systems. "Building systems that are really adaptable to the workflow of each individual institution without spending billions of dollars rebuilding the thing" (domain expert). Another respondent - domain expert referred to "Lean Healthcare" which aims to eliminate waste, reduce costs, and improve patient outcomes by streamlining processes, reducing errors, and improving communication between healthcare providers and patients: “If you can look at a process and identify waste in that process and then figure out how to implement a digital job aid that's going to help reduce or eliminate that waste. You can potentially deliver health care for less with the system than without” (domain expert). The budgeting and funding for the implementation should be carefully planned to ensure that it remains within a reasonable and feasible budget. It is important to strike a balance between designing an effective system and ensuring that it is financially viable and sustainable. “We want

to make sure that the system is well designed, make sure that the budgeting and the funding is there, that it's within a cost that's not prohibitive for the country” (decision maker). While the initial costs of implementing and maintaining EMRs can be significant, the potential financial benefits associated with their use, such as increased productivity, reduced costs, and improved reporting capabilities, can make them a worthwhile investment for healthcare organizations: “Can we deliver health care at the same cost or lower cost by using these tools? And the cost really comes into this because of the sustainability concern. I think it's easy to build expensive systems that can improve outcomes, but it's not a sustainable solution” (Domain expert).

Theme 9. A reliable and performant EMR requires a well-trained user base and a robust infrastructure.

To ensure that an EMR system works well, healthcare organizations must invest in appropriate training for staff, robust IT infrastructure, and local support services. These resources help ensure that the system functions smoothly and supports the delivery of high-quality patient care: “One of the things that gives me more confidence is uh recommending an EMR that is supported by a community. Because, I mean, in the community chances are that many people would have looked at if there are any problems, many who have had a chance to look at it...So that, of course, reduces the chances of problems with the system” (Decision maker). Users who are well-trained also have an influence on the quality of EMRs, thus impacting data quality: “I think most of the challenges related to poor usability, poor quality data. Because you are going to hire a record person, who has a little bit of knowledge about computers to input information, which you as a health worker should have input. And maybe this record person has no medical background, what you read and what you record data is not what you meant. And putting that source of

information in the system. So, it takes me back to building the capacity of our health workers to be able to use hardware computers” (decision maker).

Theme 10. Tailoring EMRs to the specific needs of healthcare providers and specialties enhances care delivery efficiency.

Customizing EMRs to meet the specific needs of healthcare providers and specialties can enhance its usefulness, usability, and satisfaction, resulting in more efficient care delivery. This aspect involves the integration of EMRs with existing clinical workflows and the adaptation of the system to the unique needs of different clinical departments and specialties. "It should be something that's intuitive for the health worker" (EMR builder and implementer). In addition to accessibility and accuracy, reporting capabilities are also crucial for efficiency in healthcare. EMRs offer custom report generation and data visualization tools that allow healthcare providers to analyze patient data efficiently: "Most electronic medical records are not able to facilitate that report...when they are due to sending reports, they need to go through a lot of hard to crunch whatever data" (decision maker). It is important to establish clear policies and procedures for managing data in order to ensure that patient data is handled in a more efficient way: "So as transparency in the sense that if there is a governance framework, for example, if there are standards to be met. If they are, let's say, minimum dataset, for example, I use the simplest. There should be a clarity that for this program, this is the minimum" (EMR builder and implementer). Finally, it is extremely important to customize the EMR to fit the needs of each country's healthcare system: "EMRs were designed for the sake of EMRs just to fulfill donors' objectives. Total lack of governance in the sense that there is no minimum data source, again,

which essentially feeds into the countries, whatever the countries policies or the countries thoughts processes in terms of HIV epidemics and response" (EMR builder and implementer).

While efficiency was the most commonly mentioned domain by all participants, there were some differences between groups' responses within this domain. Most of the comments made by EMR builders and implementers in terms of efficiency focused on workflow integration and user satisfaction. In contrast, decision makers emphasized the importance of capacity building and infrastructure development. Furthermore, domain experts stressed the importance of technical support and training for physicians, as well as delegating documentation tasks to low-skilled workers to free up time for highly trained physicians.

Equity.

Equity means "Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, race, geographic location, and socioeconomic status" (Six domains of Healthcare quality, 2022). Only few stakeholders discussed the need to establish clear policies and procedures for the management of patient data within EMRs to ensure that patient information is treated fairly and equitably. Additionally, some of the respondents mentioned the importance of ensuring that EMRs are available to all healthcare providers and patients, regardless of their location or resources, in order to ensure equitable access to healthcare information and services for all. Surprisingly, "equity" was discussed only a few times by respondents. Builders and implementers of EMRs mentioned equity in 3% of their responses, decision-makers in 0.66%, and domain experts in 2.86% of their responses (Figure 1).

Theme 11. EMRs ensure equitable access and fair data management for all healthcare providers and patients.

“Equitable meaning, you know, everyone should be able to benefit from these solutions. That's why, for example, in the Sub-Saharan setting, we sometimes look at technologies like USSP technology alongside the smart phone to make it possible for even some manual as rudimentary phones to be able to benefit from digital solutions out there” (EMR builder and implementer). As part of equity, it is important to establish clear policies and procedures for managing data in order to ensure that patient data is handled with the utmost privacy and security. “Low quality EMRs I first go back to governance. I think about that. The first thing I go into governance with data in this sense is that before EMR should be built on the very first time, there needs to be a consensus of course, what you want to collect. What is agreed to collect. Aspects of data, privacy etc.” (EMR builder and implementer).

It is worth noting that EMR builders and domain experts referred to the domain of equity more frequently than decision makers, who only mentioned the term in 7.3% of cases. Respondents from Zimbabwe made up the majority of those who mentioned the term "equity," accounting for approximately 30% of all citations. In general, equity was the least discussed domain than other domains, suggesting a gap in this area.

Patient-centeredness.

The term “patient-centeredness” refers to “Providing care that is respectful of and responsive to individual preferences, needs, and values and ensuring that people’s values guide all clinical decisions. Care transitions and coordination should not be centered on health care providers, but

on recipients” (Six domains of Healthcare quality, 2022). Patient-centeredness domain was one of the “forgotten” domains: patient-centeredness was mentioned in 7% of responses by developers and implementers of EMRs, 1.34% by decision-makers, and 3.44% by domain experts (Figure 1). When discussing concerns related to patient-centeredness, respondents often discussed clinical decision support and its role in supporting timely and appropriate care processes "The system is that purpose to improve patient care and maybe help for good outcomes of patients, and reducing the latent time to someone who used to see patients" (EMR builders and implementers) “And this tool should be able to help him to collect and analyze data, know his patients more, know his clients more, and be able to act appropriately or make decisions at the appropriate time” (EMR builders and implementers).

Theme 12. EMRs prioritize patient preferences and needs.

This approach puts the patient at the center of the healthcare experience, ensuring that their values guide all clinical decisions. In this way, the care provided is tailored to the unique needs of the patient, rather than being based solely on clinical protocols or provider preferences. "As a medical doctor and a public health specialist, I think of patients first, think about their needs, what can improve patient care and what can improve their outcomes, what can make things easier for the patients" (EMR builder and implementer). Patient-centered care recognizes the importance of care transitions and coordination, ensuring that these processes are not centered solely on the healthcare providers, but also take into account the needs and preferences of the patient, which "allows the patients to get most of health care system and allows the physicians to know their patients more in-depth in order to be able to make patient-relevant or unique decisions" (EMR builder and implementer). The concept of patient-centeredness was mentioned

by EMR builders and implementers in 7% of cases, by domain experts in 3.44%, and by decision makers in 1.34%. The results show that 23.4% of the respondents were from Zimbabwe and 2.9% were from the USA. 47% of individuals who quoted patient-centeredness had 17-20 years of experience.

The STEEEP framework helps answer the question "what is quality?" by providing a comprehensive understanding of its dimensions. Once the question of "what is quality?" is answered, the focus shifts to implementation and quality assessment (Table 4), which can be seen as being more concerned with "how to achieve quality?" These aspects deal with the practical aspects of delivering quality healthcare services and ensuring that the desired level of quality is reached.

Based on these two critical aspects, we have identified the following two distinct themes.

Theme 13. Streamlined EMR implementation through leadership buy-in, effective planning, adaptability, and well-documented processes.

Having well-documented implementation practices can help ensure that the software is deployed successfully and that it functions as intended, leading to better outcomes for users and patients.

"Things that I find important is um how reusable the technology is. Is it something that has been very custom built for a very specific context. Or is it a piece of technology that is relatively adaptable and can accommodate for different contexts or use cases ... are you able to adjust the settings and things like that from the technology um in such a way that it can accommodate your use cases without the need for major sort of technical skills to do those configurations" (domain expert). Moreover, implementation of an EMR system often involves gaining buy-in and trust

from key stakeholders and users, which can sometimes necessitate a shift in perceptions and beliefs. "It is not always that decisions about EMRs will be made by technical or domain knowledgeable persons. Uh, it is possible, and it has happened that decisions about EMRs have been made by persons who either hold positions of power and sometimes political power, or they are just in the business end of things, and therefore for them usually, if you buy cheap, you are supposed to have higher returns" (EMR builder and implementer). It is crucial to have the right person involved from the beginning and for them to remain throughout the process: "Well, if the funders are deciding which system to choose, then something is already broken right? Because the funder should be the person who pays for it. They shouldn't decide which system you get" (domain expert). Trust, buy-in, and perceptions play crucial roles in the implementation of EMRs: "... consideration about the policy makers, no matter how much we want to invest, as well as NGOS. You need to get the buy-in of the policy makers at the National level. To know how we can get a buy-in from the national level. If there is no buy-in, there may be poor governance, and poor coordination" (decision maker).

A participant emphasized the importance of hands-on experience to build trust in a tool, stating that they need to "see it, touch and feel it, and test it" rather than just being told about it" (Decision maker). "Whole golden triangle. People process technology." By focusing on all three components of the "whole golden triangle," healthcare organizations can ensure a successful EMR implementation and adoption that leads to improved patient care, increased efficiency, and better outcomes" (domain expert).

One domain expert distinguished between EMR quality and utilization, emphasizing the significance of change management in EMR implementation: "Well, you see, I don't want to

conflate quality of the EMR with use of the EMR. But I think change management is just a very important consideration that is often overlooked and underfunded as well" (domain expert).

Having a well-structured plan in place is crucial for effective and efficient management of the implementation process, as any process should begin with planning: "Maybe, uh, that could be something where you know the system itself is blameless, and the implementation was terrible.

So, I said, planning is very important. If you do plan well the first time. Most of the reasons why the system failed is for planning at the end" (EMR builder and implementer).

Co-occurring with the implementation were functional requirements, cost, and evidence of scale.

"I would like to share my experience in implementing ..., we need to think about it not as something we get done simply because we have standards, but something we invest in cultivating and also offering the support needed to adhere to quality" (EMR builder and implementer).

Theme 14. EMR quality assessment.

An EMR system must be continuously tracked and assessed to ensure its performance. It involves regularly measuring key performance indicators (KPIs) and using the data collected to make informed decisions about how to improve the EMR (Pourmohammadi, 2018). "You can do desk reviews, but also you can do field visits, where this EMR is working to see how it is actually working, because sometimes you get people who give you very good presentations about an EMR. And when you go on the ground it's a different story" (decision maker). "Data quality monitoring. The somewhat different activity of assessing the reliability of the data, so somewhat. So, I don't consider comparing EMR data to paper data to be quality monitoring because I don't trust the paper data is good quality, either right? So, there's internal quality

checking of the electronic data. And then there's validation against some sort of external source” (EMR builder and implementer). Quality assessment and M&E aligned with usability and user satisfaction. “I tend to do a lot of work around process evaluation. So, looking at how well do systems actually function with the intended users in real world environments. Are they stable and usable? Do they address the information needs of the users or potential users?” (domain expert).

DISCUSSION.

As a unique contribution to the literature, our study provides a definition of EMR quality based on the six domains of the STEEEP framework. While previous publications have provided definitions of healthcare quality using EMRs, there has been a notable lack of definitions specifically addressing the quality of EMRs themselves. When discussing the quality of EMRs, all participants mentioned more than one dimension of healthcare quality, which was explained by the fact that EMRs are complex systems that affect many aspects of healthcare delivery and patient outcomes.

According to respondents, efficiency, effectiveness, and timeliness were the most frequently mentioned domains. The study findings are similar to those described in the scoping review (Daw, 2020), where the authors used the STEEEP framework to identify different domains of quality. They found that effectiveness, efficiency, and timeliness were the most commonly mentioned quality domains. In our study, we found that patient-centeredness was identified as the second least frequently coded domain, which contrasts with the scoping review conducted by Daw and colleagues. In their review, they observed that the "Patient Centered" domain was the most frequently coded and exhibited a wide range of underlying perspectives.

Furthermore, our study findings contribute to a broader literature by providing data about EMR quality and all related aspects from low-and middle-income settings, since 21 out of 27 respondents were from LMICs. We were able to see which cases had been successful and which had gaps that needed to be addressed. Additionally, we have gathered perceptions and definitions about the quality of EMRs from different stakeholder groups, including EMR builders and implementers, domain experts, and decision makers, which has provided us with a more comprehensive perspective of the issue.

Safety, timeliness, effectiveness, and other key factors are essential to implementing and evaluating EMRs. We have engaged in extensive discussions with stakeholders to ensure that these six domains are not just theoretical constructs, but practical and effective tools for evaluating and improving EMR implementation and quality. Without addressing these intersecting aspects, our efforts to improve healthcare through EMRs would be incomplete and potentially ineffective.

Safety.

All three categories of participants, including EMR builders and implementers, domain experts, and decision-makers, placed an equal focus on safety. It is consistent with the literature that demonstrates the importance of EMR safety for improving patient outcomes.

The study found that workflow integration and usability testing are essential for ensuring patient safety and data protection. Participants in the study stressed the importance of ensuring that EMR implementation is integrated with clinical workflows in a manner that does not negatively

impact patient safety. It is consistent with previous research that has emphasized the importance of workflow integration in improving patient safety (Ratwani, 2017).

Usability testing is also considered to be an essential component of ensuring the safety of EMRs by the study participants. Software usability testing is an essential element of the software development life cycle, as it assists in the identification and correction of potential safety issues before the system is deployed in a clinical environment. Research conducted by Bowman and colleagues (2013) has shown that usability testing can be used to identify and address potential safety issues in EMRs. It was also noted that data protection and backup recovery measures are necessary in order to ensure patient safety, echoing the findings of Howe et al (2018). The authors have shown that data breaches and system failures can compromise patient safety in their study.

Timeliness.

A total of 18.1% of responses were related to the timeliness domain (Figure 2). In relation to the timeliness domain, the respondents mainly mentioned interoperability and clinical decision support. The most mentioned quality feature in the literature search was interoperability (Li, 2022, Zwaanswijk, 2011, Dobrow, 2019). Interoperability has a positive impact on workload and patient care when used effectively in EMRs: improvement of information quality, improvement of processes, and ease of completing tasks (Dobrow, 2019). There were some positive effects of EMR interoperability on both patient safety and medication safety or reconciliation. As a result of implementing interoperable EMHRs, data entry errors were reduced, and data quality and scope were improved overall (Classen, 2020, Palojoki, 2021).

EMR interoperability can be tailored to meet four aspects of EMR quality, including completeness and integrity, adherence to interoperability standards, user-centered design, and integration with clinical decision support. Clinical decision support has garnered significant interest in the literature due to its potential in improving patient outcomes, as evidenced by various studies (Gonzalez, 2015, Kokol, 2022). In our study findings workflow integration and clinical decision support were frequently co-occurring within the "timeliness" domain.

Effectiveness.

The Effectiveness domain accounted for 25.4% of the responses (Figure 2). In relation to the effectiveness domain, respondents were mainly concerned about data availability, data quality, and user-centered design. The study findings highlighted the importance of accurate and timely patient data in healthcare and emphasized that accessibility alone is not enough. Developers and implementers expressed concern over low-quality EMRs that generate poor-quality data and reports or take too long to generate reports. These findings are consistent with the importance of obtaining data from EMRs discussed in the book by Ehrenstein et al. (2019). The article noted that EMRs can generate large amounts of data, making it difficult for healthcare providers to find and use the information they need. Furthermore, Verma et al. (2021) analyzed the impact of an open-source medical record system, OpenMRS, on healthcare delivery globally and found that it streamlined operational processes, improved data availability and quality, and improved healthcare delivery, but also faced challenges with finding skilled staff and technical difficulties. An EMR for providing targeted and timely adherence counseling has been linked to clinical decision support within the effectiveness domain in order to improve healthcare interventions. This is echoing with a study conducted by Puttkammer et al. (2020) in Haiti, health workers

perceived a clinical decision support tool that can be used to identify patients who would benefit from in-depth counseling on adherence as an effective means of identifying those patients most likely to fail treatment.

Efficiency.

Responses to the Efficiency domain accounted for 27.2% of all responses. The respondents predominantly focused their discussion on usability and user satisfaction, cost, and workflow integration within the “Efficiency” domain. A variety of publications included usability as a category in addition to availability and informativeness (Kralj, 2015). According to Pruitt (2021), Workflow Support (33.5% of comments), Visual Display (20.1%), and Data Entry (14.4%) were the most frequently discussed usability topics.

Within the “efficiency” domain, our study highlights the financial considerations of implementing and maintaining EMRs in healthcare organizations. These findings align with a systematic review on the value of EMRs, which found a combination of positive and negative impacts on financial and clinical outcomes and emphasized the importance of defining the value of EMRs in relation to these two outcome categories (Modi, 2022).

As part of the efficiency domain, the use of appropriate training, information technology infrastructure, and local support services is also critical to the development and maintenance of a reliable and efficient EMR. As Shah et al. (2020) point out, EMR systems need to be optimized in order to reduce the burden on clinicians and improve their well-being. Strategies such as EMR optimization sprints, work design approaches, in-basket management techniques, and team-based workflows can enhance the efficiency and usability of EMR systems and reduce clinician

burdens. Participants in our study also recognized the importance of change management in EMR implementation, which involves managing the transition to a new system and training and supporting clinicians.

According to Vainiomäki and colleagues (2020), it is important to develop EMR systems that take into account the different demands and workflows of different healthcare environments in order to support physician well-being. By integrating EMRs with existing workflows, authors' conclusions echo our study findings regarding the importance of tailoring EMRs to the specific needs of healthcare providers and specialties.

Equity.

It was surprising to see the least mention of equitable domain, only 2% of all responses were directed to equity. Dow and colleagues report that equitable domain is the "forgotten aim" of STEEEP. Overall, the term "equity" was mentioned less frequently in relation to other domains suggests that there is a gap in this domain. This gap could be explained by issues related to measuring equity. Measuring equity can be complex and challenging, and different stakeholders may have different understandings of what it means to achieve equity in healthcare (Penman-Aguilar, 2016). As a result, it is possible that participants did not feel equipped to discuss equity in the context of EMR quality or did not prioritize it as highly as other domains. Furthermore, it is possible that there are underlying equity issues in the development and implementation of EMRs that are not being captured in the discussion. The fact that equity was mentioned less frequently highlights the need for further exploration of this issue and suggests that it may not be receiving the attention it deserves in discussions about EMR quality.

Patient-centeredness.

There was little concern among stakeholders regarding patient-centeredness, with only 3.49% of respondents mentioning it. Butler and colleagues (2020) suggest that EMR systems should be continuously developed and improved to support patient-centered care, which is in accordance with the findings of our study. As Brands et al. (2022) demonstrate, patient-centered care is of paramount importance. A study by Brands et al. showed that the use of patient-centered digital health records in individuals with chronic health conditions who are not hospitalized could result in significant improvements in health care utilization, treatment adherence, and self-efficacy.

We have already addressed the concerns discussed earlier within the comprehensive STEEEP framework, but now we are focusing on two overarching areas such as the *implementation* and *quality assessment* of EMRs.

This study reaffirms the significance of implementation and quality assessment as two overarching aspects of quality, in line with the findings in existing literature which emphasize the importance of effective implementation practices and continuous evaluation of EMRs. A study conducted by Rizer et al. (2015) highlights the importance of leadership, initial approach, training, support, optimization, and specific components of an EMR system as key lessons learned.

Our findings are in accordance with a systematic review that supports the use of EMRs for quality measurement, emphasizing the limitations of manual chart abstraction and the importance of assessing the reliability of data (Donnelly et al., 2022). As contrasted with our study, Donnelly's review stresses the effectiveness of EMR-enabled Measurement Feedback Systems

(MFSs) with support from clinical leadership. Although both studies acknowledge that EMRs can reduce data collection burdens, further research is necessary to ensure a broader implementation of these systems.

Strengths and Limitations.

The study possesses multiple strengths, including the inclusion of participants from diverse settings and backgrounds across 14 countries, which enriches the generalizability and external validity by encompassing a wide array of perspectives, experiences, cultural influences, societal factors, and contextual considerations. Additionally, the study benefits from a substantial sample size of 3 pilot interviews and 27 main interviews, ensuring data saturation. The involvement of participants from various stakeholder groups enhances the research's relevance and applicability, while the study's findings hold potential for guiding future investigations.

The study has several limitations that should be acknowledged. There was unequal sample size for each category of participants. EMR builders and implementers accounted for 16 participants, domain experts accounted for 5, and decision makers accounted for 6. As a result, it is possible that we did not achieve saturation, where no further significant information can be gathered, for all participant categories. The majority of our study's participants were from African countries, which could limit the generalizability of our findings to other regions of the world. This concentration can be explained by the fact that PEPFAR has invested strongly in scaling EMRs for HIV treatment programs in LMICs, especially in the African region. This means that the findings may not be fully representative of the entire population and may not provide a complete understanding of the research question.

CONCLUSION.

The definition of EMR quality and its associated concerns varied among different stakeholders, revealing notable trends. EMR builders and implementers expressed heightened concerns about clinical decision support and data quality. Decision makers emphasized the significance of stakeholder engagement and capacity building, while domain experts highlighted the importance of technical aspects in EMRs.

Effectiveness and efficiency stood out as prominent domains. When it comes to effectiveness, participants highlighted the impact of EMRs on clinical decision support, data availability and quality, and meeting functional requirements and standards. In terms of efficiency, interviewees highlighted cost of EMR, infrastructure, technical capability, the sustainability of EMR, and the amount of training required. Interoperability and data exchange were mapped in several domains such as safety, timeliness, and effectiveness. Although all participants agreed that EMRs should support quality of care, there was notable lack of discussion of patient-centeredness. Participants emphasized the need for a tool that is user-centered and designed with users in mind. Domain equity was the least mentioned domain, indicating that there is a gap in this area. Clearly, this issue needs further investigation, and perhaps it is not receiving the attention it deserves in discussions about the quality of EMRs.

The STEEEP framework offers a comprehensive understanding of quality dimensions in healthcare, exploring "what is quality?". It further highlights the crucial aspects of implementation and quality assessment, delving into the practicalities of delivering high-quality healthcare services and ensuring the attainment of desired quality levels.

Implications for healthcare quality:

1. **Enhancing Effectiveness and Efficiency:** Healthcare organizations should prioritize leveraging EMRs for decision support, improving data quality and availability, meeting standards and requirements, and addressing cost, infrastructure, and training needs.
2. **Prioritizing Interoperability and Data exchange:** EMR systems need to be developed based on standards that facilitate seamless data sharing, ensuring timely access to patient information and enhancing safety and effectiveness in healthcare delivery.
3. **Addressing Patient-centeredness gap:** Healthcare organizations should focus on incorporating patient-centered design principles, considering patient needs, preferences, and engagement to ensure that EMRs support high-quality care delivery.
4. **Investigating Equity in EMR quality:** Due to the existing “equity” gap, it is imperative to investigate further in order to promote equitable access and outcomes in the implementation of EMRs.
5. **Considering Implementation and Quality Assessment:** Implementation factors, such as requirements, cost, and scalability, should be considered in the design and planning of EMR systems for effectiveness and financial viability. Quality assessment should also focus on usability and user satisfaction to ensure that EMRs effectively meet end users' needs and support their daily activities.

These implications can guide healthcare organizations and policymakers in their efforts to improve EMR quality, promote user-centered design, foster interoperability, address equity considerations, and ensure successful implementation and assessment of EMR systems.

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Table 1. Definitions of Quality of Care Dimensions (National Academies of Sciences, 2018).

Dimension	Definition
Safety	“Avoiding harm to patients from the care that is intended to help them.”
Effectiveness	“Providing services based on scientific knowledge to all who could benefit, and refraining from providing services to those not likely to benefit (that is, avoiding both overuse of inappropriate care and underuse of effective care).”
Patient-centeredness	“Providing care that is respectful of and responsive to individual preferences, needs, and values and ensuring that people’s values guide all clinical decisions. Care transitions and coordination should not be centered on health care providers, but on recipients.”
Timeliness	“Reducing unwanted waits and harmful delays for both those who receive and those who give care; reducing access barriers and financial risk for patients, families, and communities; and promoting care that is affordable for the system.”
Efficiency	“Avoiding waste, including waste of equipment, supplies, ideas, and energy, and including waste resulting from poor management, fraud, corruption, and abusive practices. Existing resources should be leveraged to the greatest degree possible to finance services.”
Equity	“Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, race, geographic location, and socioeconomic status.”

Table 2. Characteristics of Participants.

		Region	Total	Decision-makers	EMR builders and implementers	Domain experts
Sex	Female		9	3	4	2
	Male		18	3	12	3
Country	Kenya	East Africa	11		5	
	Uganda			2	2	
	Rwanda			1		
	Tanzania				1	
	Nigeria	West Africa	3	1	1	
	Cameroon				1	
	Malawi	Southern Africa	7		2	1
	Zimbabwe				1	
	Mozambique				1	
	Namibia				1	
	South Africa					
	United Kingdom	Other	6	1		
	USA				1	3
Switzerland	1					
Years of experience in current role	1-4 years		11	2	8	1
	5-8 years		7	1	3	3
	> 9 years		8	2	5	1

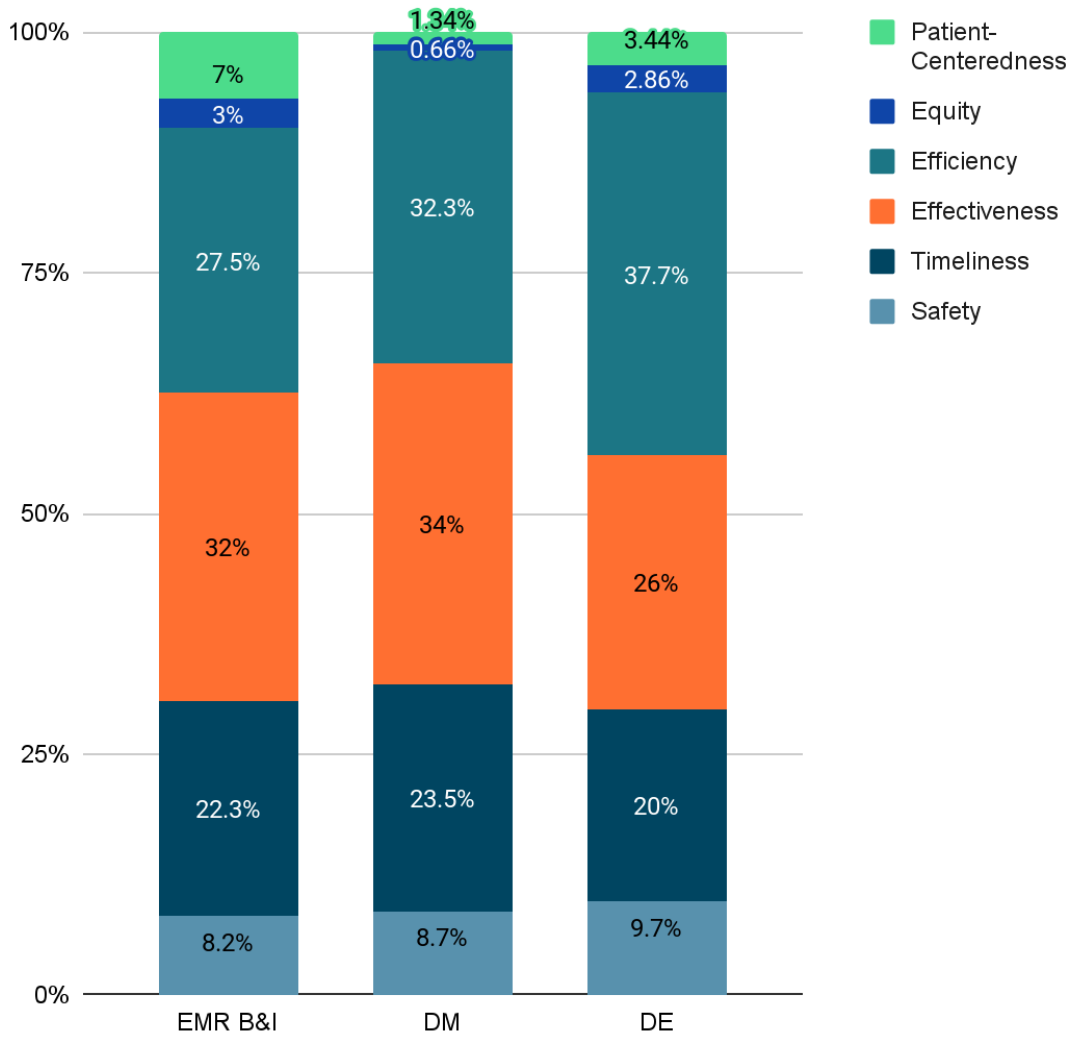
Table 3. Themes based on the six domains of healthcare quality.

Themes			
Safety	EMRs protect safety and confidentiality of patient health data.	EMRs align with clinical workflows so data are accurate and complete.	
Timeliness	EMRs provide timely support for clinical decisions and workflows.	EMRs empower timely patient care with fast and secure data exchange across all EMR locations.	
Effectiveness	EMRs provide comprehensive and accurate data reports.	EMRs achieve consistent functionality and use at scale.	User-centered EMRs to optimize clinical decision support.
Efficiency	Financial impact of EMRs	A reliable and performant EMR requires a well-trained user base and a robust infrastructure.	Tailoring EMRs to the specific needs of healthcare providers and specialties enhances care delivery efficiency
Equity	EMRs ensure equitable access and fair data management for all healthcare providers and patients.		
Patient-centeredness	EMRs prioritize patient preferences and needs.		

Table 4. STEEEP-Plus Framework: STEEEP-IQ

STEEEP-IQ	
Implementation	Streamlined EMR implementation through leadership buy-in, effective planning, adaptability, and well-documented processes.
Quality assessment	EMR quality assessment.

Figure 1. The percentage of coded segments belonging to any of the six domains identified by the stakeholder groups.

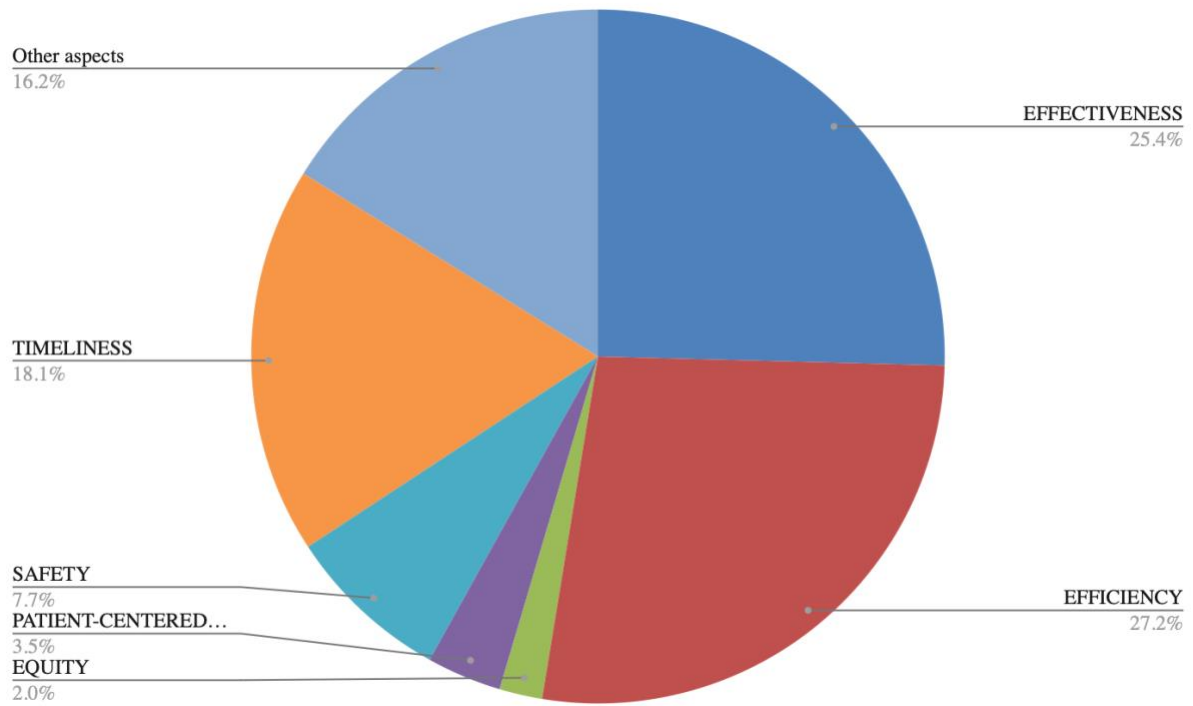


EMR B&I - EMR builder and implementer

DM - Decision maker

DE - Domain expert

Figure 2. Percentage of all coded segments allocated to each domain.



Appendix. Questionnaire guide.

	Main question	Follow-up questions and probes
	Research question: How do people define quality EMRs based on their role?	General probes for all questions - What do you mean by? - Tell me more about... - Give me an example of... - Tell me about a time when... - Tell me who/when/where... - Walk me through..
Intro	Intro to study script	
	Questions about Digital Health Interventions	
1	In just a few sentences, briefly tell me about your background, experience in health care and with electronic medical records, and your current role.	
2	What do you think about when deciding to select or invest in a digital health product?	
3	How do you define "good quality" for a digital health tool?	
	Questions about EMRs	
4	Now let's talk about Electronic Medical Records or EMRs. When you think about the quality of EMRs, what five words or ideas come to mind?	
5	Tell me more about each of the 5 words or ideas. For example, what do you mean by {insert one word or idea from interviewee}?	- What do you mean by? - Tell me more about... - Give me an example of...

6	How do EMRs fall short of quality?	When you think about low quality EMRs, what examples come to mind?
7	What do you see as your responsibility in the quality of an EMR?	As another way to think about this, in your role, how would you assure the quality of an EMR?
8	If you were going to recommend an EMR, how would you determine if it was high quality and worthy of recommendation?	Does communicating the quality of EMRs change based on the role of the person you are recommending to? What kind of activities might be conducted to assess quality?
9	Finish this sentence when someone is telling you about an EMR they are recommending... "This EMR is good quality because _____"	In other words, What do you need to know here to feel you can trust the quality of an EMR?
10	What do you suppose others consider when assessing whether they can trust the quality of an EMR, particularly those who hold roles different from you?	Who are the others and their roles that you are referring to in this question
11	Is there anything that we have not covered that you would like to share about your experiences with the quality of EMRs or trusting an EMR?	
Demographic questions & experience		
12	Now I have just a few demographic questions...	Please indicate your country of origin and the country you are based in now
13		What is your current organization, your job title or role, and how long have you been in this role?
14	Do you have anyone that you would recommend we connect with for this study? Would you introduce us?	